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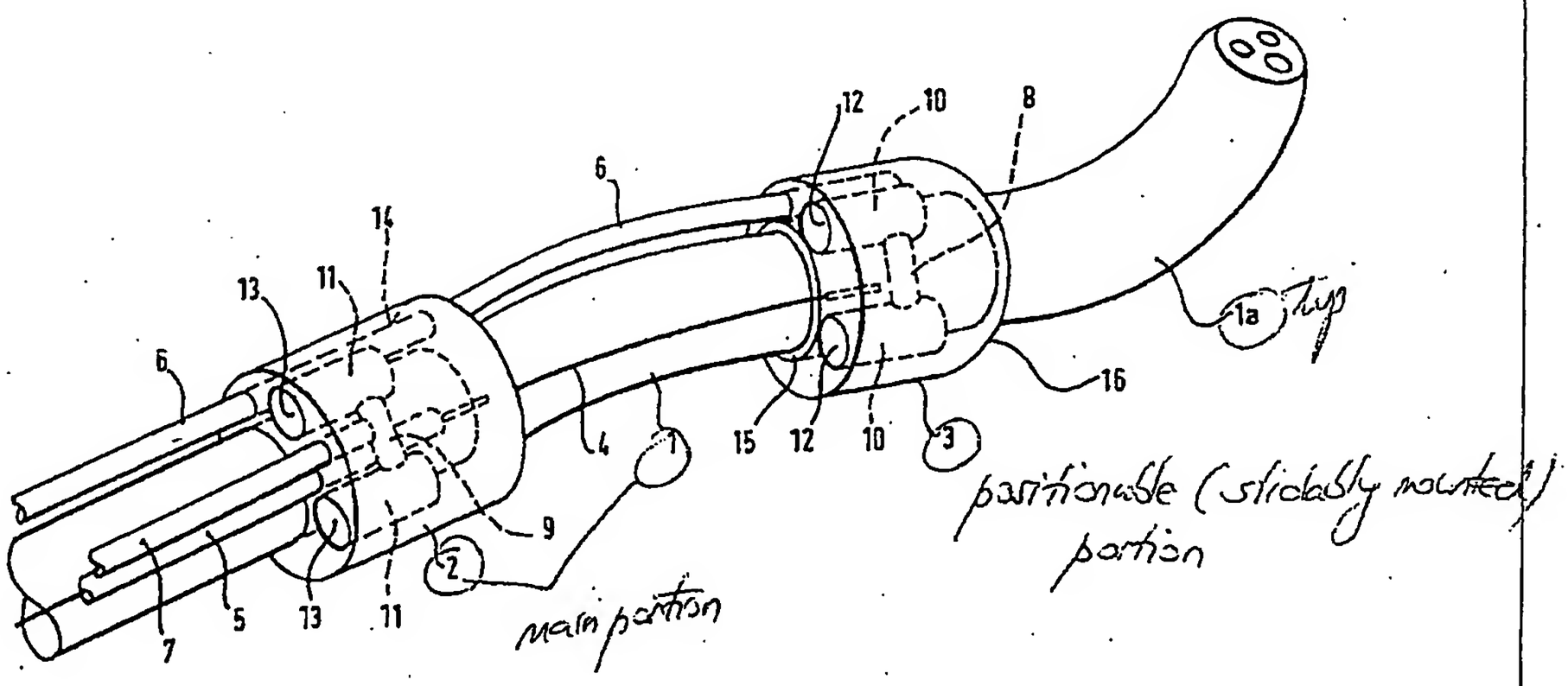
(54) Title: SUCTION MEANS FOR PROPELLING AN ENDOSCOPE



(57) Abstract

An endoscope (1), is provided with a suction head (2, 3) mounted for longitudinal movement with respect thereto. The suction head is arranged, when actuated, to grip the tissue of the body passage such as the colon or small bowel, in which the endoscope (1) is disposed. The endoscope may have a first suction head (2) and a second suction head (3) longitudinally of the endoscope. Movement may be effected by means of a Bowden cable (4, 5).

SUCTION MEANS FOR PROPELLING AN ENDOSCOPE

This invention relates to a device, for example an endoscope or similar instrument, having means for propelling it along a tortuous passage. Although the invention is not limited to medical applications, the inventors have in mind particularly the problems associated with small bowel endoscopy and colonoscopy.

During colonoscopy, for example it is well known that difficulties often arise with pushing the colonoscope through the bends in the colon. When the endoscopist pushes on the colonoscope there is a tendency for the colon, which is in effect a floppy and poorly supported tube, to form an arc or loop, so that further pushing serves only to expand the arc or loop and does not advance the tip of the colonoscope. If the instrument is pushed too hard the wall of the gut may be damaged.

More generally the problem that this invention seeks to overcome is that any instrument designed to be pushed along a tortuous passage must be flexible enough to negotiate the corners yet at the same rigid enough to avoid buckling or forming loops. This invention seeks to avoid this dilemma by providing a means of propulsion at or near the distal tip of the instrument so that it can pull itself through the passage.

The history of colonoscopy has been one of improving instruments for pushing through the anus and along the colon. However, the first successful total colonoscopy was achieved in 1965 by Provenzale and Revignas who simultaneously pushed and pulled a colonoscope through the anus and along the entire length of the large bowel. The pulling involved a long string (actually a small calibre rubber

tube) which had previously been swallowed by the patient who still had one end emerging from his mouth (Provenzale L, Revignas A. Metodica originale di esplorazione strumentale trans-anale polivalente del colon intero. Rass Med Sarda 1966:69:131-140). This technique, involving end-to-end intestinal intubation, did not prove popular and endoscopists reverted to pushing the instrument along the colon.

The obvious desirability of having an instrument that could pull itself along a tortuous tube has led a number of workers to describe methods of providing traction at the distal end of the endoscope. So far as we are aware none of these techniques have been used with humans.

The most common approach has been to imitate the motion of an earthworm by attaching inflatable segments to the endoscope. As described by Frazer (Apparatus for endoscopic examination, US patent 4,176,662) there are two radially expandable bladders separated by an axially expandable bellows with only the forward bladder attached to the endoscope. The sequence of operation is that (1) the rear bladder is expanded to anchor it against the colon wall, (2) the bellows are then expanded to push the front bladder (and hence the endoscope) forwards, (3) the front bladder is inflated so that it is locked in place against the colon wall, then (4) the rear bladder is deflated and finally (5) the bellows are contracted to draw the rear bladder forwards ready to start the next cycle. Variations on the worm theme can be found in patents by Lyddy et al (US patent 4,690,131), Krasner et al (US patent 4,676,228), Utsugi (US patent 4,148,307), Shishido et al (US patent 5,090,259) and Grundfest et al (US patent 5,337,732).

A number of other methods of propulsion have been suggested. For

significantly impairing its function.

It is possible that a single sucker could be used; for example a cup could be pushed forward from the tip of an endoscope and then attached to the wall and used as an anchor from which to pull the endoscope forward. However, it is preferable that two or more suckers are used, so that the device can walk using the suckers as feet.

The suction cup must be lightly pressed against the tissue before the suction can grip hold of the tissue. This can reliably be achieved by sucking air out of the bowel until it collapses onto the suction cup. The moment at which the tissue becomes trapped can be monitored by the change in pressure or air flow at the vacuum pump. Once the tissue has been trapped in the suction cup, the lumen of the bowel can be reflated to facilitate advancing the endoscope and inspecting the bowel.

In the accompanying drawings:

Figure 1 is a perspective view of an embodiment of the present invention; and

Figures 2a and 2b illustrate a situation which shows the desirability of using a Bowden cable.

Figure 1 shows a flexible endoscope 1 having a flexible tip 1a. The endoscope is provided with two annular suction heads 2, 3 with the distal head 3 able to slide along the endoscope, while the proximal head 2 is fixed to the shaft of the endoscope with an easily removable adhesive, or a collet or other clamping device. The two heads are moved relative to each other by means of a Bowden cable whose inner wire 4 is stiff enough to push the distal head forward without